Questions:

1) What are pharmacy organizations and schools doing to educate pharmacy students, trainees, and pharmacist practitioners about Personalized Health Care?

2) What and how should we be teaching the public and health professionals about Personalized Health Care as it relates to:
   – role of new drugs?
   – new roles of old drugs?

American Association of Colleges of Pharmacy (AACP) Academic Affairs Committee (2002)

- Competencies in Pharmacogenetics and Pharmacogenomics for Pharmacists derived, in part, from Core Competencies in Genetics Essential for All Health-Care Professionals, National Coalition for Health Professional Education in Genetics (NCHPEG)

- I. Genetic basis of disease
  - A. Knowledge
  - B. Skills
  - C. Attitudes

- II. Drug discovery and disposition/drug targets
  - A. Knowledge
  - B. Skills
  - C. Attitudes

- III. Ethical applications, social and economic implications


- Developed a 10-item list of Recommendations and Call for Action for Deans of pharmacy, medicine, and nursing faculties


- Identified essential elements for pharmacy curricula:
  - Genetic basis for disease and drug action
  - Genetic basis for alteration of drug metabolism
  - Genome and proteomic principles in relation to disease and drug development
  - Genetic basis for individualizing drug doses
  - Genetic basis for antibody synthesis, development, function, and immunopathology

American College of Clinical Pharmacy (ACCP) Educational Affairs Committee (2010)

- Identified four essential components of a pharmacy curriculum related to advances in genomics:
  1) Personalized medicine concepts and terminology, with a focus on genomics;
  2) Genomic applications in basic and applied pharmaceutical sciences;
  3) Biotechnology; and
  4) Bioinformatics

- For each component, the following were developed:
  - Curricular Outcome
  - Discussion
  - Suggested Implementation
  - Benchmark Performance Measures

- Unlike previous white papers and guidelines, this Committee actually provided suggestions for specific curricular changes to address each competency.
  - Pharmacotherapy 2010;30:228e–235e
Three recent surveys of US and Canadian pharmacy schools (continued)

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Hours of PG content included in curriculum</th>
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<tbody>
<tr>
<td>Murphy et al (2010) Respondents: 75/90 US pharmacy schools (83.3% response rate)</td>
<td>Mean = 10.1 hours</td>
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<tr>
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<td>Median = 7.0 hours</td>
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<td>Std. Dev. = 7.2 hours</td>
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<td></td>
<td>10 to 30 hours</td>
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<td>40.6% (N=28)</td>
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<td>11 to 30 hours</td>
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<td>42.0% (N=29)</td>
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<td>31 to 60 hours</td>
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<td>14.5% (N=10)</td>
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UBC Faculty of Pharmaceutical Sciences

Systems Medicine Research Stream

- "will bring together basic, clinical, and pharmacy practice researchers inside and outside the Faculty of Pharmaceutical Sciences with a common interest in developing a community dedicated to the application of pharmaceutical science and practice to the creation of personalized, proactive, predictive, and participatory patient care"

- one of the goals is: "to develop education curricula and syllabus to educate patients, pharmacists, physicians, and graduate and undergraduate students in systems medicine"

American College of Clinical Pharmacology

http://user.accp1.org/index_new.html

Health Care

This Time It’s Personal
PERSONALIZED HEALTH CARE—it deserves the hype!

- Is fundamentally different
- Although in its infancy, it offers promise of being able to personalize medical care in preparation rather than in response
- However, at this time, unclear what that potential will be
PERSONALIZED HEALTH CARE - EDUCATION

“WHAT IS?”

“WHAT IF?”

What should we be teaching the public and health professionals about old drugs and new drugs, with the benefit of this 20/20 hindsight of how rapidly technology evolves?

<table>
<thead>
<tr>
<th>PUBLIC</th>
<th>HEALTH PROFESSIONALS</th>
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<tbody>
<tr>
<td>Old Drugs</td>
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<td>New Drugs</td>
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</table>

Old Drugs: PUBLIC

- High variability in effectiveness, safety, and toxicity across individuals.
- With few exceptions, do not know why that variation occurs and cannot accurately quantify it

Example: Warfarin
- Combination of CYP2C9 and VKORC1 genotypes, age, height, body weight, interacting drugs, and indication
- Explains ONLY ~55% of warfarin dose variability


New Drugs: PUBLIC

- As new drugs emerge, will understand more about their characteristics which will have both positive and negative impact:
  - positive - they may be more effective in some patients; there may be less adverse effects in targeted populations

Example: Abacavir
- Patients with HLA-B57 mutation have higher incidence of potentially life-threatening hypersensitivity reaction
- New labelling for abacavir recommends genetic test to screen patients for potential interaction
As we become increasingly effective at subtyping diseases and mechanisms of actions of drugs, we will be telling patients:

- "Some drugs may not be suitable for you" (i.e., there may be less hope)
- "Your cholesterol-lowering agent could be highly effective in 70% of the patients, but we’re not even going to start the drug in 30% of the patients because the risk-benefit ratio is poor"

Educate the public on how drug therapy is going to be increasingly individualized and give weight to discouraging practices (e.g., sharing medications)

What has been easy to explain (i.e., "don’t use your friend’s antibiotic because they may have a different infection") may be extended to all drugs

Population data will be much less relevant

Historically, vast majority of information has focused on new drugs

Once health professionals have gained experience with old drugs, did not have too much more to learn

Have to convince practitioners to learn new things about old drugs that they thought they already knew everything about!

Have new rapidly evolving body of information to help improve selectivity and specificity of therapeutic approaches

For example, in recent years, revised labelling for several existing drugs to include information on genetic variants linked to adverse drug effects or drug efficacy

(e.g., irinotecan, 6-mercaptopurine, carbamazepine, phenytoin, clopidogrel, and warfarin, abacavir, etc.)

Need to teach general principles while both acknowledging and preparing health professionals for a world in which those principles are going to change

New drugs for which practitioners’ experiences and body of information are evolving rapidly

Paradigm Shift

PAST and CURRENT ERA: Trial and Error (“Reactive testing”)

FUTURE ERA: Fewer Trials and Less Error (“Proactive testing”)
New Drugs: Health Professionals (continued)

Paradigm Shift

Examples:
- NNT
- Patients’ prior knowledge
  Patients are no longer subordinate, passive recipients of physician-initiated genetic testing; rather, patients can instigate their own testing and often know more than their clinicians about particular genetic topics. Indeed, health care providers are increasingly bypassed altogether, as patients embrace direct-to-consumer (DTC) genetic tests and turn to social networks for help in interpreting their results. – Evans JP et al. 10.1056/nejmtp1006202

PERSONALIZED HEALTH CARE- EDUCATION

<table>
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Health Scientists
- Engage health scientists to invest time and energies in elucidating mechanisms and relationships that have to date eluded us
- Will require data sharing in an unprecedented manner as in Alzheimer’s Disease Neuroimaging Initiative
  - In 2004: NIH, FDA, pharmaceutical and medical-imaging industries, universities and nonprofit groups collaborated on project to find biological markers that show progression of Alzheimer’s disease
  - Unprecedented sharing of all data - every finding publicly available immediately to anyone anywhere in world
  - To date, >3,200 downloads of entire huge dataset and almost one million downloads of datasets of images from brain scans.

Health Scientists (continued)
- Need to get past the traditional secrecy and commit to a free and open sharing of information
- People used to say that “Information is power”
- But, the Internet changed that to:
  “Power comes out of sharing information, not holding it.”
Example: Project Gutenberg
  - Founded in 1971, has taken books no longer copyrighted and put them on line for free
  - Is the oldest digital library (most items are full texts of public domain books, made as free as possible in long-lasting, open formats that can be used on almost any computer)
  - As of December 2009, Project Gutenberg claimed >32,000 items in its collection

Health Scientists (continued)
- Need to imagine: 1) Direct application of a single piece of information and 2) Integration of multiple sources of information
- Through the power of networking, we can bring new meaning to old information!
- Example: Michael Hayden and Bruce Carleton’s Genotype-Specific Approaches to Therapy in Childhood [GATC] Research Program
  - Using two unique Canada-wide surveillance networks, clinicians and scientists have collected an enormous amount of information
    - not just for analysis in the here and now,
    - but also in anticipation of technology advances to better interpret the information in the future

Questions:
For Personalized Health Care:
We need to anticipate the volume, complexity, and variability of the information and imagine:
- How will we create the Wikipedia of Personalized Health Care and ensure that the content is complete and accurate?
- How will we create the Google for Personalized Health Care and ensure that the results are selective, specific, and relevant?